Minor Miscellaneous Exploratory/Experimental Fishing Activities in the Caribbean and Adjacent Waters

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ABSTRACT—The Caribbean Fishery Development Project conducted nearly five years of experimental, exploratory, demonstration, and simulated production fishing activities within its sphere of operations during Project Phases I and II. This paper describes work of lesser importance whose results were not significant enough to warrant separate presentation. It is concerned mainly with reporting the results of the exploration of small resources or the infrequent application of certain fishing techniques to larger resources.

During deepwater bottom longlining explorations, an average catch rate of 0.5 pound per hook was observed. A maximum catch rate of 1.0 pound per hook was observed in 105-195 fathoms of water 100 miles north of Paramaribo, Surinam. The catch composition was 80 percent tilefish, 16 percent grouper, and 4 percent miscellaneous.

Bait trawling operations, as an adjunct to shark fishing, provided an opportunity to test the effectiveness of a small, 38 × 44 foot, specially made trawl with that of the trawl used during Calamar's *exploratory trawling cruises. The small net caught a lesser proportion of marketable food fish, which suggests that the larger, higher opening nets will catch a greater proportion of off-bottom seatrout and croaker than a small bottom-hugging net.*

Pelagic fish attraction experiments confirmed that drifting objects will attract an aggregate of pelagic fishes that will vary, but generally increase in size and species complexity with time. A small concentration of scallops was located in 40 fathoms of water, 10 miles northwest of Los Testigos Islands, Venezuela. Later attempts to delineate the extent of the concentration were not successful. Project fishing operations with gill nets covered a wide scope of locale and timing, although total effort was small. Only during night drift operations and daytime anchored bottom netting off Trinidad was any success achieved.

Most of the exploratory and/or experimental fisheries operations of the Caribbean Fishery Development Project were of sufficient magnitude to warrant individual reports. This report has been prepared to summarize all of the miscellaneous exploration accomplished on minor resources and miscellaneous experimental fishing efforts accomplished by the Project. Included are experimental and exploratory deepwater bottom longlining, incidental trawling (consisting mostly of shark bait trawling), experimental attraction of surface pelagic species, scalloping, and gill netting accomplished by Project vessels: *Alcyon*, *Calamar*, and *Fregata*. None of the subjects covered is considered to possess more than slight commercial potential, but is presented herein as a portion of the total exploratory/experimental work accomplished and for general information on overall fishing interest in the Caribbean.

DEEPWATER BOTTOM LONGLINING

During October 1967 and January 1968, the U.S. National Marine Fisheries Service (then, Bureau of Commercial Fisheries) fishery research vessel, *Oregon II*, conducted deepwater longlining operations between

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30 and 300 fathoms around the periphery of the Gulf of Mexico (Nelson and Carpenter 1968). Although the catches were concluded to be generally insufficient to support any commercial effort, a significant showing of tilefish (*Lopholatilus chamaeleonticeps*) was observed. Off the north Gulf Coast catches approached ¼ pound per hook between 163 and 187 fathoms off Texas and Louisiana, catches in excess of ¼ pound per hook were made between 138 and 162 fathoms, and approaching ½ pound per hook between 188 and 212 fathoms.

Tilefish

The tilefish has been the object of fisheries, but mostly in the past. A few are caught incidentally by snapper boats and landed in U.S. Gulf Coast ports. Bigelow and Schroeder (1953) report an extensive fishery off the central Atlantic coast of the United States in the latter half of the last century. This fishery was greatly curtailed by an extensive mortality of tilefish near the end of the last century and the fishery has never really recovered.

A depth/temperature/bottom-type regime similar to that off the eastern U.S. was found to exist on the edge of the continental shelf north of the Guianas. Consequently, during cruise 68-13, *Calamar* made two experimental bottom longline sets of 75 hooks each, between 100 and 200 fathoms 60 miles east-northeast of Waini Point, Guyana. Five tilefish were caught, which proved their existence in the project region and stimulated additional exploratory activity.

Area and Effort

Subsequent to the first deepwater bottom longline sets mentioned above, *Calamar* completed 43 additional sets either on a specific cruise (69-7) or as an adjunct to experimental/exploratory shark fishing cruises (69-10, 70-8) (Table 1). Sets were made off the edge of the continental shelf from Guyana to French Guiana in waters from 100 to 225 + fathoms deep (Fig. 1).

Gear

The standard fishing gear utilized during deepwater longline explorations is diagrammed in Figure 2. It consisted of a 1,000 foot ¼ inch tarred nylon mainline (tuna longline) anchored with expendable weights at each end. Each end was also buoyed with a flag marker. Branch lines were clipped on at about 10-foot intervals. Each branch line consisted of a No. 8 or 9 tuna circle hook (A) fastened to a 1 foot wire leader (B), attached to 18 inches of 190-pound test nylon monofilament (C), then a No. 8/0 barrel swivel (D) and snap on attachment (E), which could be placed anywhere on the main line.

Hooks were baited with squid, shark meat, or seatrout.

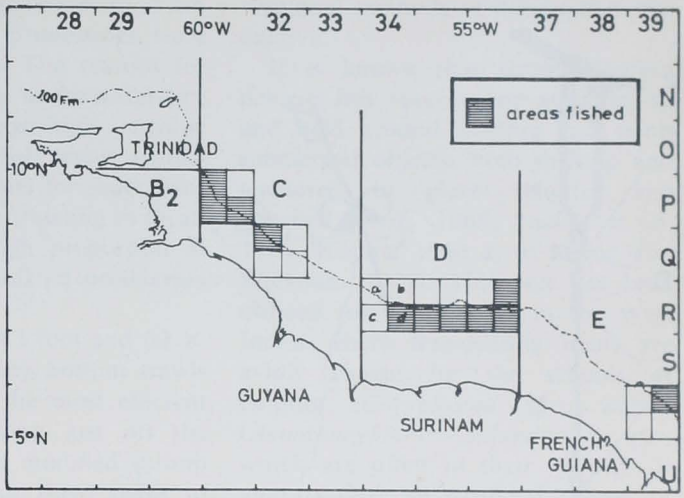

Figure 1.—Northeastern South American coastal shelf showing grids (areas) where deepwater setlining occurred.

Method

The gear was set from the stern of the moving vessel. First a flag buoy was thrown overside, which dragged after it a buoy line longer than the expected water depth. The anchor, attached to the end of the buoy line and to one end of the main line, was then thrown over. As the main line paid out, prebaited branch lines were clipped on at approximately 10-foot intervals until 100 hooks had been attached. The second anchor was fastened to the mainline, then thrown out along with the second buoy line and buoy.

The gear was soaked from 1 to 3 hours after which it was recovered over the starboard waist of the vessel

Table 1.—Record of deepwater longline sets. (Fish catches given in numbers - pounds.)

Date	Cruise	Station	Lat. (N)	Long. (W)	Grid	Depth range	Number of hooks (recovered)	Tilefish catch	Grouper catch	Other fish total[1]	Total catch
9 Dec. 68	68-13	639	8°51′	58°51′	Q-32a	105-120	75	3 - 30	2- 50	1- 17	6- 97
10 Dec. 68	68-13	641	8°51′	58°49′	Q-32a	160-200	30	2 - 66	—	—	2- 66
24 June 69	69-7	769	9°34′	59°38′	P-31a	135-150	105	13 - 94	—	—	13- 94
24 June 69	69-7	770	9°33′	59°38′	P-31a	125-138	105	3 - 31	1- 9	1- 6	5- 46
26 June 69	69-7	771	9°06′	59°12′	P-31d	138-150	187	3 - 26	3- 80	2- 20	8- 126
26 June 69	69-7	772	9°23′	59°34′	P-31c	120-145	44	—	1- 7	—	1- 7
18 Sept. 69	69-10	815	7°25′	55°32′	R-35c	150-155	100	—	—	6- 70	6- 70
26 Sept. 69	69-10	825	7°22′	56°12′	R-34d	138-159	100	4 - 75	—	1- 20	5- 95
26 Sept. 69	69-10	826	7°20′	56°01′	R-34d	141-162	100	1 - 21	—	—	1- 21
1 Oct. 69	69-10	831	7°28′	54°29′	R-36d	123-125	100	—	—	—	—
1 Oct. 69	69-10	832	7°32′	54°28′	R-36b	150-153	100	—	—	—	—
1 Oct. 69	69-10	833	7°35′	54°28′	R-36b	170-183	100	—	—	—	—
2 Oct. 69	69-10	835	7°37′	54°23′	R-36b	195-200	100	—	—	—	—
2 Oct. 69	69-10	836	7°34′	54°40′	R-36b	192-194	100	—	—	—	—
3 Oct. 69	69-10	838	7°27′	55°05′	R-35d	195-225	100	5 - 95	—	—	5- 95
3 Oct. 69	69-10	839	7°25′	55°09′	R-35d	126-195	100	8 - 120	1- 25	—	9- 145
3 Oct. 69	69-10	840	7°25′	55°10′	R-35d	127-141	100	5 - 67	—	—	5- 67
7 Oct. 69	69-10	843	7°29′	54°08′	R-36d	148-150	99	—	—	—	—
7 Oct. 69	69-10	844	7°32′	54°06′	R-36b	172-174	99	—	—	—	—
8 Oct. 69	69-10	846	7°28′	54°57′	R-36c	180-183	200	1 - 10	—	—	1- 10
9 Oct. 69	69-10	847	7°25′	54°59′	R-36c	156-165	100	3 - 81	1- 31	—	4- 112
9 Oct. 69	69-10	848	7°25′	55°02′	R-35d	156-195	100	8 - 90	—	—	8- 90
9 Oct. 69	69-10	849	7°28′	55°03′	R-35d	140-165	100	10 - 164	2- 31	—	12- 195
9 Oct. 69	69-10	850	7°28′	55°05′	R-35d	140-160	100	1 - 13	1- 10	—	2- 23
15 Oct. 69	69-10	862	7°21′	55°10′	R-35d	156-186	98	3 - 67	—	—	3- 67
15 Oct. 69	69-10	863	7°21′	55°12′	R-35d	120-162	98	9 - 140	—	—	9- 140
15 Oct. 69	69-10	864	7°20′	55°14′	R-35d	105-159	98	8 - 101	—	—	8- 101
15 Oct. 69	69-10	865	7°20′	55°15′	R-35d	120-180	98	3 - 54	—	—	3- 54
16 Oct. 69	69-10	866	7°22′	55°17′	R-35d	105-186	98	5 - 95	—	—	5- 95
16 Oct. 69	69-10	867	7°19′	55°17′	R-35d	107-135	98	9 - 101	—	—	9- 101
18 Nov. 69	69-10	885	5°50′	51°25′	T-39b	150-225	200	—	—	—	—
7 Aug. 70	70- 7	1089	7°18′	55°48′	R-35c	137-195	300	26 - 246	3- 66	—	29- 312
7 Aug. 70	70- 7	1090	7°17′	55°48′	R-35c	145-168	90	6 - 80	2- 40	—	8- 120
8 Aug. 70	70- 7	1091	7°18′	55°51′	R-35c	124-165	300	6 - 70	—	—	6- 70
8 Aug. 70	70- 7	1092	7°17′	55°52′	R-35c	119-183	236	8 - 110	3- 56	—	11- 166
8 Aug. 70	70- 7	1093	7°17′	55°54′	R-35d	90-174	280	6 - 49	8- 89	—	14- 138
9 Aug. 70	70- 7	1094	7°18′	55°52′	R-35c	120-180	314	15 - 209	5- 82	—	20- 291
9 Aug. 70	70- 7	1095	7°18′	55°53′	R-35c	180-215	305	2 - 22	—	—	2- 22
9 Aug. 70	70- 7	1096	7°18′	55°39′	R-35c	115-170	293	1 - 13	—	—	1- 13
10 Aug. 70	70- 7	1097	7°18′	55°56′	R-35c	144-165	301	3 - 18	—	—	3- 18
10 Aug. 70	70- 7	1098	7°21′	56°02′	R-34d	126-180	296	18 - 224	—	—	18- 224
10 Aug. 70	70- 7	1099	7°21′	56°02′	R-34d	159-188	298	14 - 112	—	2- 20	16- 132
11 Aug. 70	70- 7	1100	7°21′	56°02′	R-34d	147-192	299	2 - 29	—	—	2- 29
11 Aug. 70	70- 7	1101	7°21′	56°03′	R-34d	147-186	294	6 - 75	—	—	6- 75
11 Aug. 70	70- 7	1102	7°20′	56°03′	R-34d	117-170	280	4 - 48	—	—	4- 48
						Totals	7,118	224 -2,846	33-576	13-155	270-3,575

[1]Mostly sharks.

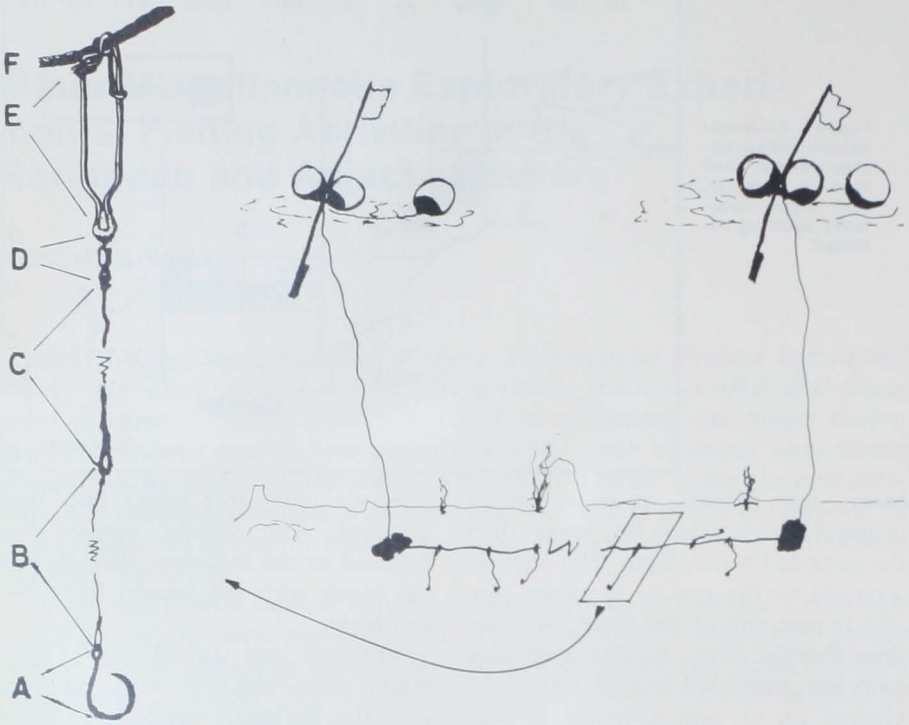

Figure 2.—Deepwater bottom longline with details of branch lines.

using the main winch to haul, while steaming upwind to the gear. The buoy lines were coiled by hand and the main lines run on a drum of the trawl winch. Branch lines were detached as they came over the rail.

Results

The results of each deepwater longline set are given in Table 1. A total of 224 tilefish weighing 2,846 pounds was taken during the exploratory period. Added to this were 33 grouper (mostly yellow edge, *Epinephelus* sp.) weighing 576 pounds, plus 13 miscellaneous (mostly sharks) at 153 pounds, making a grand total of 270 fish, weighing 3,575 pounds taken during the total 45 sets.

In Table 2, the catch is broken down by areal grid. The appropriate grids are shown in Figure 1. The highest catch of tilefish was observed in Grid R 35 d, while Grid R 35 c had the greatest total poundage of fish.

When the catch per set of tilefish was plotted against the number of hooks per set and the number of hours per set, both showed some degree of positive correlation. The peaks appeared at about 300 hooks/set and 3.5 hours soaking.

The commercial potential for deepwater longlining in this general area appears to be only marginal. In area R 35 d (between 100 and 200 fathoms, north of Surinam) the best catch rates were observed. These only approached one per hook. It would therefore require at least three sets of 100 hooks, soaking for over 3 hours per set to even expect commercial quantities. There are no data on population density, but it is concluded to be only slight to moderate because of the precipitous nature of the continental slope at the depths where tilefish, the principal species, is found.

This type of fishing could be done to supplement snapper fishing on the shelf edge and is advised for this only.

INCIDENTAL TRAWLING

The trawlfish resource off the northeastern coast of South America was found to be the largest fishery resource inside the Project region. During 20 cruises in 1967 and 1968, *Calamar* expended 700.0 hours on trawling effort to capture over 490,000 pounds of fish (Rathjen, Yesaki, and Hsu 1969). Upon completion of this work, eight cruises were devoted to exploratory and experimental shark fishing in the shallow (shore to 100-fathom curve) region depicted in Figure 1. A necessary addition to shark fishing was the procuring of bait. This required trawl fishing and to some extent represented a follow-up to the large scale exploratory trawling operations already completed. This report is based on the results of all shark bait trawling and some minor experimental shrimp trawling efforts conducted off Jamaica during *Alcyon* cruise 71-4a.

Gear and Methods

The shark bait trawl was designed and constructed by the Project. It is a modified shrimp net 43 feet long, having 2 inch stretched mesh throughout, excepting for a 1½-inch cod end. The 38-foot headrope was normally fitted with 5-7 can floats while the 44-foot footrope was chain-weighted. The net wings were fastened to the 3 × 6 foot 250 pound chain-bridled doors with 3 foot straps. The doors were fastened to the ends of a 20-fathom ½-inch wire towing bridle, which was in turn shackled to the ½-inch single trawl wire.

The net was set from the forward gallows on the starboard side, while the vessel steamed at a moderate speed in a wide circle to starboard. A depth to trawl wire scope rate of 3 or 4 to 1 was used in waters 10 to 30 fathoms deep. Tow length was usually ½ to 2 hours, which was determined by the immediate need for bait and

Table 2.—Deepwater bottom longline catch by statistical grid.
(Fish catches given in numbers - pounds.)

Grid	No. of sets	Total no. hooks	Total no. hrs.	Tilefish catch	Grouper catch	Other catch	Total catch	Catch/ hook	Catch/ hr.
P-31a	2	210	5.1	16- 125	1- 9	1- 6	18- 140	0.66	27.4
P-31c	1	44	2.5	—	1- 7	—	1- 7	0.16	2.8
P-31d	1	187	5.2	3- 26	3- 80	2- 20	8- 126	0.67	24.2
Q-32a	2	105	4.0	5- 96	2- 50	1- 17	8- 163	1.55	40.8
R-34d	7	1,667	21.2	49- 584	—	3- 40	52- 624	0.37	29.4
R-35c	10	2,519	29.4	73- 817	21-333	6- 70	100-1,220	0.48	41.5
R-35d	12	1,188	30.8	74-1,107	4- 66	—	78-1,173	0.99	38.1
R-36b	5	499	11.8	—	—	—	—	—	—
R-36c	2	300	7.9	4- 91	1- 31	—	5- 122	0.41	15.4
R-36d	2	199	5.2	—	—	—	—	—	—
T-39b	1	200	2.3	—	—	—	—	—	—
Totals	45	7,118	125.4	224-2,846	33-576	13-153	270-3,575	—	—

whether immediately previous tows in the same area had yielded good results.

The net used for shrimp trawling in Jamaica is the same as that used for trawling lobsters (Chislett and Yesaki 1971) except for the addition of a ¼-inch mesh cod end liner.

Results

One hundred and forty-one shark bait tows, occupying over 239 hours, yielded a total of 50,315 pounds. Of this total, 17,924 pounds (35.6 percent) were marketable fish, 23,165 pounds (46.1 percent) were industrial fish (catfish, sharks, skates, and rays) and 9,226 pounds (18.3 percent) were invertebrates, including shrimp. Of the marketable fish caught, 5,917 pounds (33.0 percent) were seatrout, 3,340 pounds (18.7 percent) were croaker, 4,395 pounds (24.5 pecent) were whiting, and the remainder (23.8 percent) were mixed fish. Shrimp made up 5.6 percent of the invertebrate catch.

Although shark bait was trawled from Trinidad to French Guiana, emphasis was placed on the areas off the Corontyne and Surinam Rivers off Surinam, and off Waini Point, Guyana.

Three 15-minute drags were made in the Portland Bight area off the south coast of Jamaica on *Alcyon* cruise 71-4. No shrimp were caught, but a few invertebrates and small sciaenid fishes were taken. A fourth drag was attempted off the mouth of Black River, but the net was nearly destroyed and shrimp trawling efforts were terminated without tangible result.

Discussion

Even though shark bait trawling was conducted in the same general areas as *Calamar* exploratory food fish trawling, the catch proportions were dissimilar (Table 3). The reasons for this are felt to be due to the difference in fishing gear (a large high opening light trawl for food fish versus a small size bottomhugging net for shark bait) and the emphasis on trawling in localities displaying a high proportion of seatrout during simulated production food fish trawling.

The large (70 × 83 foot and 60 × 80 foot) high opening bottom trawls are designed to be the most efficient at catching fish living just off the bottom. Since it is a modified shrimp trawl, the shark bait trawl tends to fish closer to the bottom. The shark bait net caught a lesser proportion of marketable fish (principally seatrout and croaker), but a greater proportion of industrial fish and invertebrates, including shrimp. It is apparent then that anyone intending to use modified shrimp nets as production fishing gear for marketable fish species, might expect to obtain only about one-fourth to one-third as much seatrout and about half as much croaker as he might catch by using the larger, lighter high opening trawl used for food fish explorations.

FISH ATTRACTION

At the outset of this project, the Caribbean was felt to hold a large resource of surface and subsurface pelagic fish species. After a number of cruises including surface longlining, live bait, pole-and-line fishing, trolling, and some surface gill netting had taken place with only limited success, it was decided that the resource was perhaps not as extensive as first hoped and what fish did exist tended to be relatively scattered, making the conventional methods of fishing less productive.

It is known that certain surface pelagic fish species are attracted to and held around floating and semi-submerged objects, both drifting and anchored in place (Hunter and Mitchell 1967, 1968; Inoue, et al. 1968; Kojima 1960 a, b; Klima and Wickham 1971). This fact has been utilized for many years in the West Indies where free-drifting items are avidly sought for the schools of dolphin (*Coryphaena* sp.), wahoo (*Acanthocybium solanderi*), etc., which are often in their vicinity. It appears that an artificial means of concentrating surface pelagic species could provide for increased catches in the Caribbean Fishery Development Project region.

Anchored Objects

The Project, on several occasions, anchored structures in attempts to assess their attractivity. A list of anchored structures is given in Table 4.

In total, 12 anchored rafts were placed in the eastern Caribbean for varying periods during 4 years. None of these were considered to have shown a significant positive result. Most were lost for one reason or another after only a short period of anchorage. Some of these losses were the result of interference from local fishermen.

Drift Fishing

In February 1969, the U.S. research vessel *Discoverer* attracted large quantities of dolphin fish while drifting for 17 days, as a portion of the Atlantic Tradewind Expedition (Potthoff 1969). The attraction was an indirect one, as the dolphin were attracted to forage

Table 3.—Comparison of *Calamar* exploratory food fish trawling and *Calamar* shark bait trawling by area.

Zone[1]	Orinoco (B2)		Guyana (C)		Surinam (D)		French Guiana (E)		Totals	
	Food fish explorations	Shark bait	Food fish explorations	Shark bait	Food fish explorations	Shark bait	Food fish explorations	Shark bait	Food fish explorations	Shark bait
No. of stations	6	3	46	41	236	77	30	20	318	141
Time (Hrs.)	9.8	5.0	67.1	56.4	562.3	141.1	41.7	36.6	680.9	239.1
Total catch (percent)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total fish catch/lb.	11.3	88.8	92.2	63.8	97.8	86.8	80.5	90.4	95.4	81.7
Marketable fish/lb.	10.1	50.7	75.3	35.4	68.6	35.0	52.6	38.2	67.8	35.6
Trout/lb.	7.2	2.2	8.9	9.7	44.1	14.3	15.2	2.0	39.7	11.8
Croaker/lb.	0.5	12.5	23.1	10.8	10.0	5.5	1.6	3.1	10.4	6.6
Mixed/lb.	2.4	36.0	43.3	15.0	14.5	15.2	35.8	33.2	17.7	17.2
Industrial fish/lb.	1.1	38.9	14.9	28.3	29.2	51.9	27.9	52.2	27.7	46.1
Invertebrates/lb.	88.7	11.2	9.8	36.2	.2.2	13.2	19.5	9.6	4.5	18.3
Shrimp/lb.	(0.1)	(2.3)	(0.0)	(0.8)	(0.2)	(1.2)	(0.5)	(0.3)	(0.2)	(1.0)

[1]From Rathjen et. al 1969.

species (flyingfish, squids, etc.) which had been attracted to the vessel's lights. The numbers of dolphin were seen to increase daily until at the end of the drift, it was estimated that there was one dolphin per square yard of sea surface within sight of the vessel.

Since the experience gained during the placing of the four anchored fish attraction rafts off Barbados in 1968 pointed up the problems of anchored devices close to land, another device was sought. Based on the experience of *Discoverer*, a drift fishing cruise by a Project vessel was conceived.

Calamar Cruise 70-5

In May of 1970, *Calamar* conducted experimental drift fishing during cruise 70-5 (29 April - 18 May 1970). The objects of the cruise were:

1. To determine if a drifting vessel could attract a marine colony containing commercially desirable species in commercially significant quantities.
2. To gauge the effect of continued drift on the cumulative size of any colony attracted.
3. To test various fishing methods on any fish attracted.

It was proposed that the hull of *Calamar* should be the fish attractor. Lights were rigged overside at night to increase attraction. After taking on live bait in Man-of-War Bay, Tobago, *Calamar* proceeded to a point about 200 miles southeast of Barbados. This position was calculated to allow the vessel to drift close to Barbados for whatever effect the land might offer in concentrating fish. The vessel was tethered to two 27-foot diameter personnel parachute sea anchors. These reduced wind drift by holding the vessel into the wind and sea and also provided for a smoother condition aboard. After transiting about 360 track miles in 314 hours, the drift was terminated some 20 miles west of St. Lucia (Fig. 3). The average speed throughout the drift was about 1.1 knots, but during some days over 35 miles were covered in 24 hours with speeds up to 2.5 knots observed over shorter periods.

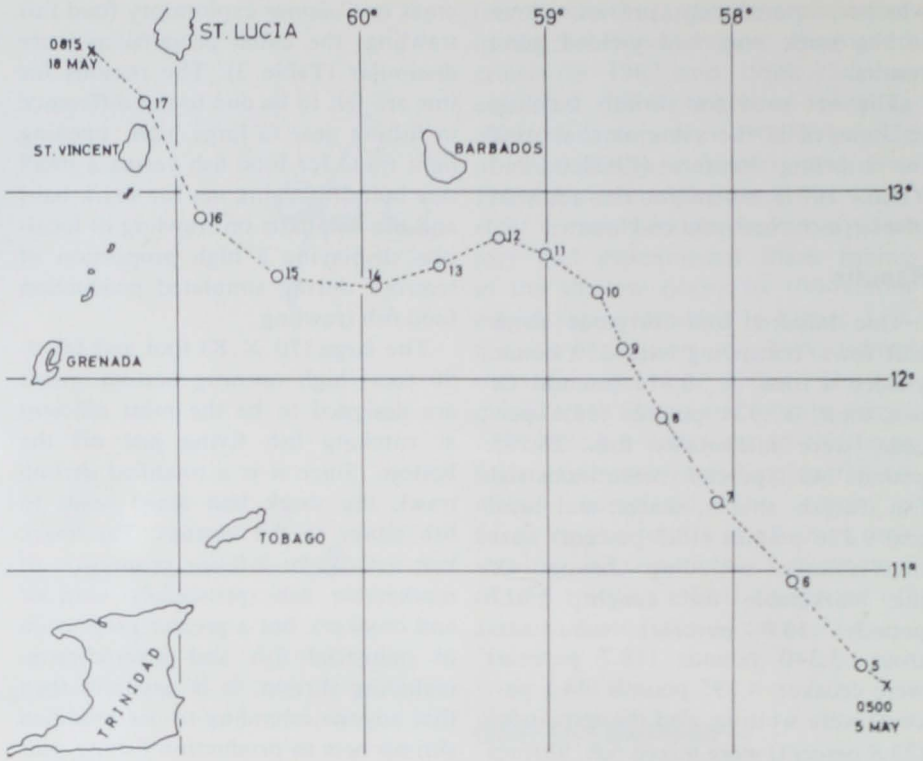

Figure 3.—Drift track—*Calamar* Cruise 70-5. Circles indicate noon position of vessel; numbers are day of month.

For fishing equipment, the vessel carried handlines, tuna pole-and-line rigs, sport rods and reels, an 18 foot outboard-powered dory rigged for trolling, 5½-inch and 1¾-inch mesh gillnets, 10 baskets of tuna longline, and dip nets. Live and frozen fish bait were also carried.

A summary of the catch by drifting day is presented in Table 5. Fourwing flyingfish, *Hirundichthys affinis*, was the first species attracted to the vessel. A few were taken on the first drifting day. After 200 pounds were caught using handlines, dip nets, and gill nets, no additional flyingfish, except those dipped for live bait, were taken in order to retain any attractive force a school of this species may have exerted on the larger pelagic fishes. Dolphin fish were taken from the deck of *Calamar* using handlines, rod and reel, and pole-and-line, all using live fish for bait. Once a dolphin was attracted to the boat, it appeared to remain in the vicinity until finally caught, even though it might have been previously hooked and lost. For this reason, it is felt that a very high proportion (90+ percent) of the fish attracted to the vessel were eventually caught. Wahoo were shy and, even though they were observed jumping in the vicinity of the vessel, none were caught until the skiff was placed overside to troll around the vessel. (At the termination of the drift, seven wahoo were taken in the immediate area within 15 minutes by trolling from the *Calamar*.) From this first day of drifting, the vessel appeared to acquire

Table 4.—List of anchored fish attraction structures.

Date	Structure	Location	Longevity	Results
12 Feb. 68	Bamboo bundle	Kleijn Curacao, N.A.	5 days (lost)	Nil
15 Feb. 68		Kralendijk, Bonaire, N.A.	2 days (lost)	Nil
1 Apr. 68	Bamboo covered wood frames	London Shallows, Barbados	14 days (lost)	Nil
1 Apr. 68			1-2 mo. (lost)	Nil
1 Apr. 68			(lost)	4 dolphins - 80 lbs.
1 Apr. 68			(lost)	Nil
1 Aug. 69	Bamboo bundle	N. Anguilla Bank	7 days (set adrift)	Nil
10 Feb. 71		270 fm. S. of Barbados	6 days (lost)	1 dolphin - 12 lbs.
14 Apr. 71		190 fm. N. of Barbados	5 days (lost)	Nil
24 May 71	Floating fish pot		1 day (sank)	Nil
28 May 71		Middle Shallows, Barbados	2 days (terminated)	fish reported
19 June 71		N.E. Anguilla Bank	6 days (terminated)	3 barracuda

Table 5.—Daily fish catch of *Calamar* Cruise 70-5 while drifting.
0 = NUMBERS (000) = POUNDS

Fish Species	May 5	6	7	8	9	10	11	12	13	14	15	16	17	18	Totals
Flying-fish	-(200)														-(200.0)
Dolphin			3	25	1	4	1	5	8	12	6		13	1	79
			(56)	(468)	(16)	(93)	(33.5)	(106)	(136)	(232.5)	(117.5)	—	(239)	(20)	(1,517.5)
Wahoo					1	2				4	2			7	16
					(21)	(29)				(54.5)	(21)			(108)	(233.5)
Yellowfin tuna				1		2	42	19	3	8	9		28	1	[1]113
				(135)		(12)	(349)	(130)	(35)	(71)	(63.5)		(221)	(11)	(1,027.5)
Skipjack tuna							8	1			1		1		11
							(40)	(4.5)			(4.5)		(4.5)		(53.5)
Bigeye tuna	1														1
	(115)														(115.0)
Rainbow runner					3	2	6	3	2	6		1	11	2	36
					(14)	(8)	(54)	(21)	(14.5)	(56)		(8.5)	(64)	(16)	(256.0)
Trigger-fish												-(200)			-(200.0)
Sharks	1	1		1	1			1	1	2	1	1			10
	(25)	(30)		(75)	(30)			(86)	(35)	(52)	(65)	(22)			(420.0)
Total	(340)	(30)	(56)	(678)	(81)	(142)	(476.5)	(347.5)	(220.5)	(466.0)	(271.5)	(230.5)	(528.5)	(155.0)	(4,023.0)

[1]Most of this total had previously been reported (Caribbean Fishery Development Project Cruise Report No. 28) as blackfin tuna (*Thunnus atlanticus*), but positive identification of identical fish taken from the same general geographic area and in association with the same species complex during *Calamar* Cruise 71-7 have prompted this reidentification.

a population of tuna which increased and decreased for no apparent reason throughout the 2 weeks. Small yellowfin tuna, *Thunnus albacares*, were almost always present, while skipjack tuna, *Katsuwonus pelamis*, was often seen. All of these species plus one bigeye tuna, *Thunnus obesus*, were taken on either handlines or rod and reel from the vessel. The rainbow runner, *Elagatis bipinnulata*, was very much in evidence under the vessel, but very difficult to catch and then only by heavy chumming with live bait. A few sharks were taken, but the vessel did not appear to attract sharks from long distances. The ocean triggerfish, *Canthidermis sufflamen*, was much in evidence and could be dip netted or caught on handlines. A few squids were observed and taken on jigs. Many small (2-3 inch) green jacks, *Caranx caballus*, were observed around the vessel along with other unidentified small species. The hydrographic conditions observed during the cruise were nearly stable, with surface temperatures between 27.8° and 28.5°C and thermocline depths between 85 and 100 meters.

The catch results of *Calamar* Cruise 70-5 and observations made during the voyage confirmed that a marine colony was established around the vessel during the period of the drift. The catch results do not confirm commercial quantities taken; however, a major hindrance to more thorough fishing was the inability of the vessel to utilize all of the methods available to her without seriously disturbing the established colony. Although trolling was seen to be somewhat successful, it could only be done by the skiff during the best of weather. Gill nets were set and recovered twice with extreme difficulty, while longlines could not be utilized at all.

Calamar Cruise 70-6

An opportunity to remedy the conditions observed during cruise 70-5 was presented on cruise 70-6 (26 June - 5 July) when *Calamar* rendezvoused with the papyrus sailing raft *Ra II*. This craft had sailed before the wind from the Moroccan coast of Africa before she was met by *Calamar* about 800 miles east-northeast of Barbados. Previous radio contact had indicated that a considerable body of fish, including dolphin, shark, flyingfish, skipjack tuna, etc., were being seen regularly around the raft. However, in 10 hours of fishing effort, close by the raft, using trolling lines, handlines, and one gill net set, only one small dolphin and 10 flyingfish were caught.

Calamar Cruise 71-7

Since the original objectives set forth for cruise 70-5 still had only partially been met, *Calamar* Cruise 71-7 (19 May - 5 June 1971) was conceived and carried out. In cruise 71-7, the fishing vessel placed, tracked, and monitor-fished a number of attraction structures. This allowed the vessel to use any fishing gear deemed suitable anywhere in the vicinity of structures or the surrounding area with the added advantage of more than one attraction device.

Although the cruise had been scheduled for 17 days, mechanical troubles causing the ship to return to port split the cruise into two almost equal periods. This allowed the experience gained during the first part to be applied to the work conducted during the latter part. During the first half of the cruise, three fish attraction structures consisting of a flag buoy with a radar reflector array, linked to slightly submerged West Indian "Z" fish pots (10 × 4 × 3 feet), were attached to a 24-foot diameter parachute-type sea anchor (Fig. 4a). The three structures were placed about two miles apart at the points of an equilateral triangle about 160 miles east-southeast of Barbados (Fig. 5). This location allowed for an expected drift path close to, but not intercepting, the northern Leeward Islands. With the sea anchors at about 10-15 fathoms deep, the structures did not drift appreciably. After 4 days, two of the three parachute anchors were replaced with "D" style fish pots (6 × 4 × 4 feet) which caused the structures to immediately begin to drift northward. The third structure remained behind and was eventually lost.

Keeping station on the structures was found to be difficult. The first three rafts were fitted with an array of radar reflectors which proved to be of

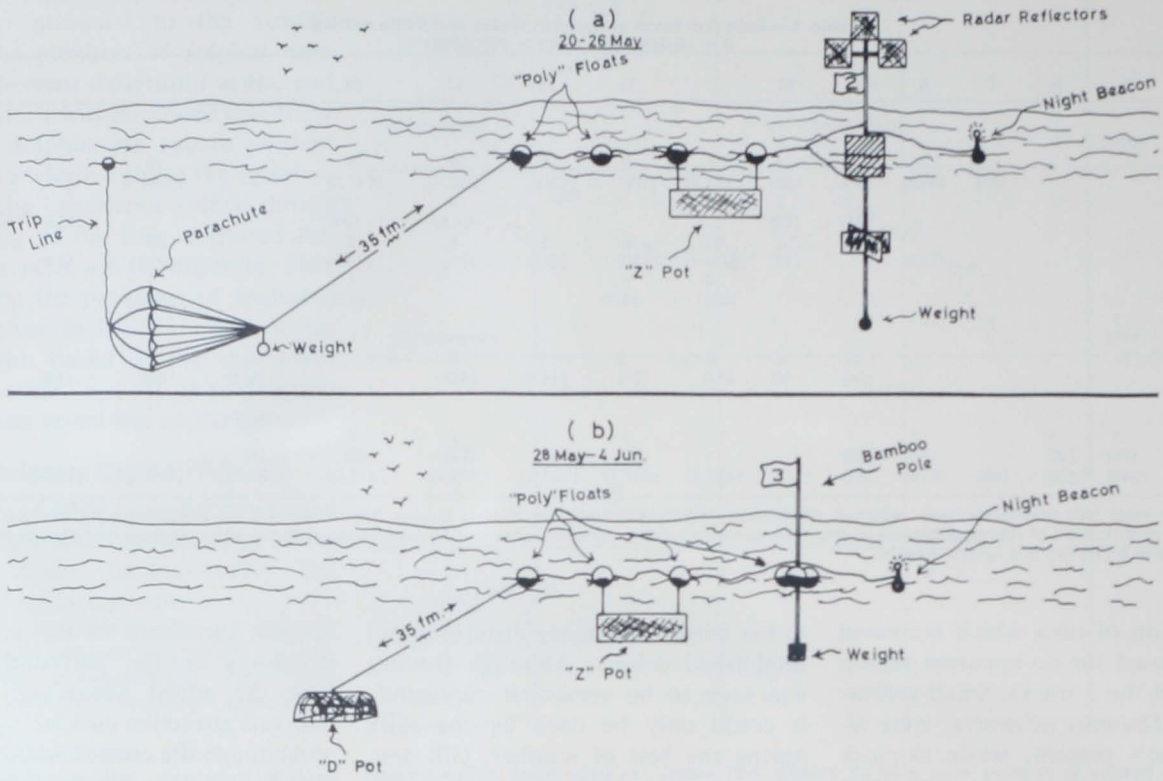

Figure 4.—Fish attraction structures used during *Calamar* Cruise 71-7.

no value as such, because the ship's radar was found to be weak and ineffective. The reflectors did provide good visibility against the horizon however, and were used to visually locate each structure. At night, the ship used two parachutes to anchor herself near the most westerly structure, to which a light beacon had been affixed. Bearings on this light were taken hourly from the ship and after sunrise, when the ship's sea anchor had been hauled, it was possible to return to the leading structure, which provided a point of departure from which the ship might locate the remaining structures.

During the second half of the cruise, six identical structures with "D" pot sea anchors and no radar reflectors (Fig. 4b) were placed on an east-west line at 1.5-mile intervals, approximately 30 miles east of Barbados. Based on the experience of the first half of the cruise, a northerly drift was expected; however, after 7 days all the structures had drifted westerly around the south end of Barbados and generally northwesterly until they intercepted St. Lucia (Fig. 1). One structure lost its sea anchor and was taken aboard after 5 days' drifting. The remaining five structures had spread in a rough line, 25 miles long, which split in passing St. Lucia, causing the loss of three more structures on the last day of the drift.

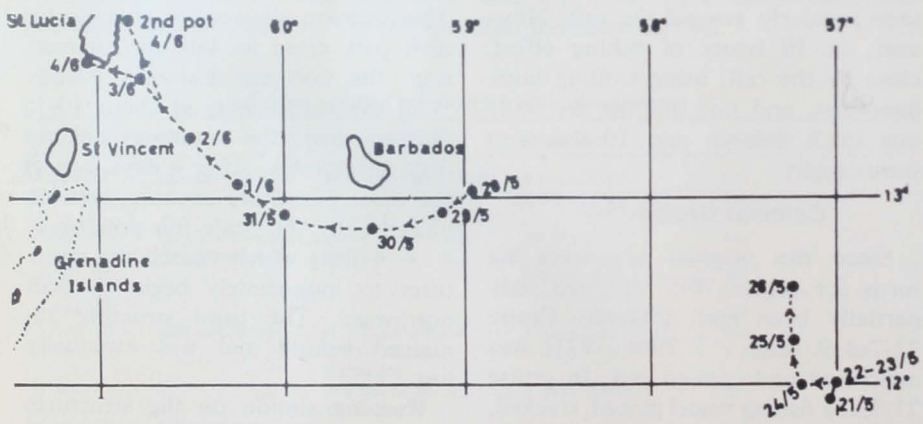

Figure 5.—Drift track—*Calamar* Cruise 71-7. Solid circles represent 0500 daily position of structures. Numbers are day/month.

Fishing techniques varied and were fitted to the conditions and type of fish in evidence. The usual technique was to monitor a structure by trolling a feather jig close to it and then using handlines if any fish were taken trolling. Handlines were fished, either drifting with live flyingfish bait (dolphin and wahoo) or trolling at slow speed with a whole or piece of dead flyingfish for bait (wahoo and rainbow runner). Sharks were taken with handlines only while drifting. All tunas were taken by trolling artificial lures. Two gill net sets, one of two shackles of 1¾-inch mesh and one immediately thereafter of three shackles, netted 237 flyingfish weighing 78 pounds. Thereafter, flyingfish were either dip-netted

Table 6.—Daily fish catch of *Calamar* cruise 71-7.
0 = NUMBERS (000) = POUNDS

Fish species	May 21	22	23	24	25	26	29	30	31		June 1	2	3	4	Totals
Dolphin	10 (167.5)	—	16 (265.5)	1 (25.0)	1 (25.0)	3 (45.0)	12 (259.0)	7 (158.0)	1 (7.0)			14 (215.0)	5 (102.0)	4 (64.0)	74 (1,333.0)
Wahoo	6 (87.5)	—		2 (22.5)		3 (46.5)						2 (23.5)	16 (150.0)		29 (330.0)
Rainbow runner		1 (10.0)			3 (22.0)	4 (36.0)	8 (79.0)	3 (26.5)	1 (12.0)						20 (185.0)
Yellowfin tuna	1 (5.0)	4 (18.0)		46 (217.0)	53 (264.0)	21 (96.0)		10 (53.0)	7 (38.0)					8 (43.5)	150 (734.5)
Skipjack tuna		7 (24.5)		9 (38.0)	29 (115.0)	4 (15.5)		3 (16.5)					3 (19.0)		55 (228.5)
Whitetip shark		3 (101.0)	1 (65.0)			4 (105.0)	2 (128.0)		2 (61.0)						12 (460.0)
Silk shark			1 (18.0)						1 (21.0)			1 (18.0)			3 (57.0)
Flying-fish	237 (78.0)														237 (78.0)
Ocean trigger-fish	7 (21.0)					3 (7.5)									10 (28.5)
Totals	(359.0)	(153.5)	(348.5)	(302.5)	(426.0)	(351.5)	(466.0)	(254.0)	(139.0)			(256.5)	(314.5)	(64.0)	(3,435)

No fish

or caught by hook and line for bait only, as it was felt that they could be an attraction on their own to larger fish when they were schooled in the vicinity of the structures.

Ocean triggerfish were removed from the near surface "Z" fish pots. The "D" pot sea anchors caught nothing. Once a shackle of 5-inch gill net 30 fathoms long was set in the midst of a school of jumping skipjack tuna, but none was caught. While drifting overnight, the vessel placed lights above and beneath the surface to attract fish. Little success was achieved.

The overall fish catch results are given in Table 6. These totals are not divided by structure fished, as it was apparent that fish were attracted and held to a structure purely through chance encounter and not because of any greater attractiveness by one structure over another. As in the previous work of this kind, dolphin fish provided the greater poundage of fish taken. Their association with the structures was marked and acute. To an only slightly lesser degree wahoos were attracted and held. The two shark species (*Carcharhinus longimanus* and *C. falciformis*) were obviously attracted and held and were in close association with rainbow runner. Flyingfish and ocean triggerfish were the first species to associate with the structures, with flyingfish dispersing immediately after the larger pelagic predators came along. The association between the structures and tunas was not a definite one. About 10 percent of the yellowfin tuna taken were caught in their immediate vicinity, but the remainder, plus all the skipjack tuna, were caught trolling, sometimes close by and other times up to 3-4 miles away from the structures.

Flyingfish attracted to the structures were often in a spawning condition so that upon final recovery, the "Z" pot and even the connection lines and floats making up the rest of the structure were covered with newly spawned eggs.

The results of this cruise did not indicate any real potential for this fishing method. Fish were attracted to the structures, probably in greater total numbers than to the ship alone. However, the difficulty in tracking each structure together with (and somewhat caused by) the spreading out and loss of the structures as time passed, with consequent lower catches, outweighed this fact.

Summary and Conclusions

The objectives set forth at the beginning of cruise 70-5 were met as follows:

1. The drifting objects (as opposed to the meager results shown by anchored objects), either boats or attraction structures, did attract and hold pelagic fish aggregations.

2. The size of the aggregation attracted did increase in size and species complexity with increased time in the water.

3. The degree of attraction was species dependent. The most strongly attracted species were dolphin fish, flyingfish, ocean triggerfish, and sharks. Next were wahoo and rainbow runner, while the tunas appeared to be least attracted.

4. The attraction of any fish appears to be due to random encounter with the drifting object and while the chances of such encounter may be slightly increased by an increase in the size of the surrounding fish aggregation, the removal of some fish does not seem to affect the overall attractiveness of the object.

From the results obtained, it must be concluded that no significant commercial potential was demonstrated by the project's experimental efforts in fish attraction.

SCALLOPS

At fishing station 491 (20 July) of *Calamar* cruise 68-7 (10-26 July 1968), two scallops (*Pecten* sp.) were trawled from about 40 fathoms, 10 miles northwest of Los Testigos Islands, Venezuela. The results of this and subsequent tows of the roller rigged 52 × 76 foot snapper trawl where scallops were caught are given in Table 7.

Since the footrope of a roller rigged trawl fishes relatively high over the bottom, it is not considered a good sampling tool for scallops. This showing of scallops, using a roller rigged trawl, was highly encouraging. A 6 foot tumbler-type scallop dredge was obtained and used during *Calamar* cruise 78-12 (28 October - 4 November 1968). The results are given in Table 8.

Although preliminary findings with unsuitable gear were encouraging, the results of scallop dredging in the area around Margarita Island and Los Testigos were unsatisfactory in terms of their commercial potential.

Table 7.—Scallop catch using roller rigged snapper trawl - *Calamar* Cruise 68-7.

Station	Date	Location (Venezuela)	Depth (fm)	Amount	Remarks
491	7/20/68	10 mi. NW Los Testigos Is.	39-40	2	
493	7/20/68	28 mi. WNW Los Testigos Is.	33	20	
494	7/21/68	20 mi. N Margarita Is.	28-33	20	
496	7/21/68	17 mi. N Margarita Is.	34-36	1½ bucket	3½-4 inch diameter
497	7/21/68	10 mi. N Margarita Is.	24-32	1 bushel	65 meats/ lb.
507	7/24/68	8 mi. W Los Testigos Is.		30	

GILL NETTING

Gill net fishing was accomplished under a variety of circumstances during the Project life. Surface-floating gill netting for medium and small sized pelagic species plus anchored bottom gill netting for demersal species all received some degree of attention. On two occasions, attempts were made to encircle surface pelagic schools with a gill net.

A total of 83 gill net sets during 10 cruises by all three project vessels yielded 2,702 pounds. Forty-three surface nets of 1½ inch monofilament net (usually one shackle of 15 × 5 fathoms) yielded 590 pounds of flyingfish (*Exocetidae*) and 515 pounds of mixed clupeid fishes. Thirty-one sets of 4¾ inch, 5 inch, or 5½ inch surface sets for medium sized pelagic species caught 1,167 pounds. Nine anchored sets of bottom net yielded 428 pounds. The encircling surface sets caught one 2-pound shark.

During *Alcyon* Cruise 67-9, small mesh surface gill netting in Kingston (Jamaica) harbor produced 515 pounds of clupeid bait fish during four nights' operations. Nylon monofilament nets for tunas and other medium sized pelagic species were fished on the banks south of Jamaica. During *Alcyon* Cruise 67-10 four sets of one 5-fathom shackle of 5 inch or 5½ inch gill net off Morant Cays produced no fish. One drifting set of 5-inch mesh caught two horse-eye jacks (*Caranx latus*) and several sharks. One encircling set around a surface school of skipjack tuna yielded nothing.

On *Alcyon* Cruises 69-9 and 10, several sets of 5-inch and 5½-inch mesh gill net on banks south of Jamaica yielded only 45 pounds of horse-eye jacks and several sharpnose sharks (*Rhizoprionodon porosus*).

Calamar Cruises 70-5 and 71-7 were devoted to fish attraction and three sets of 1½-inch mesh gill net caught 328 pounds of flyingfish. Two sets of 5½-inch mesh net, one in the midst of a school of jumping skipjack tuna, yielded only two ocean triggerfish (*Canthidermis sufflamen*).

During survey operations in the Netherlands Antilles (*Fregata* Cruises 68-1 and 68-2) 24 net hours of night time 1½ inch Barbados hung flyingfish gill net effort yielded 3.83 fish per hour, while 72.5 net hours of daytime effort produced 7.14 fish per net hour. The total catch for all effort was 251 pounds.

Fregata's Cruise 68-3 produced 35 flyingfish in eight daytime sets of 1½-inch mesh net from the waters around Barbados. Two sets of 5-inch mesh net in the same area yielded one 12 pound rainbow runner (*Elagatis bipinnulata*).

During *Fregata*'s Cruise 68-7 experimental gill netting was conducted off the coasts of Trinidad and Tobago. A total of 22 gill net sets was made, of which 12 were drift sets, 9 were anchored sets, and 1 was an encircling set. The drift sets were made along the southwest coast of Trinidad around the Serpent's Mouth. The objectives of the drift set operations were to test the relative effectiveness of monofilament and multifilament nylon gill nets during the day and night. In all but one drift set, the gear was comprised of two 60-fathom shackles of 4¾-inch monofilament gill nets strung alternately between three 60-fathom shackles of 4-inch multifilament gill nets. Four day drift sets, averaging approximately 2 hours soak, produced one Spanish mackerel (*Scomberomorus maculatus*) and one leatherjacket (*Oligoplites saurus*). The remaining eight drift net sets made at night were much more productive. These night sets were soaked for approximately 4 hours. A total of 588 fish was taken of which 329 were leatherjackets, 96 were Spanish mackerel, 95 were catfish (mostly *Arius* sp.), 19 were unidentified sharks, and 41 were miscellaneous species. The multifilament net was more effective than the monofilament net (Table 9); the former caught 17.69 fish, whereas the latter caught only 12.07 fish per shackle per set.

Anchored gill nets were fished on nine occasions during this cruise, six times off the north coast of Trinidad and three times off Tobago (Table 10). The nets used were 65 fathom (fished eight times) and 125 fathom (fished once), 4 inch multifilament gill nets. Soaking time of the six sets off Trinidad averaged slightly over 9 hours. These sets produced a total of 232 fish weighing 417 pounds. The bulk of the catch was comprised of 84 (196 pounds) Spanish mackerel and 95 (139 pounds) sharks. Anchored gill netting off Tobago was much less productive than off the north coast of Trinidad. Three sets averaging 12½ hours soaking time off Tobago produced only seven fish weighing 11 pounds.

An encircling set attempted off the north coast of Trinidad with a 125

Table 8.—Scallop catch using 6 foot tumbler dredge.

Station	Date	Location (Venezuela)	Depth (fm)	Catch
603	10/29/68	30 mi. NE Margarita Is.	33	1
604	10/29/68	10 mi. N Margarita Is.	33	1
605	10/29/68	8 mi. N Margarita Is.	33	nil
606	10/30/68	9 mi. NW Margarita Is.	31	42
607	10/30/68	9 mi. N Margarita Is.	26	33
608	10/30/68	8 mi. W Margarita Is.	26	46
609	10/30/68	10 mi. N Margarita Is.	26	nil
610	10/30/68	9 mi. NW Margarita Is.	27.5	49
611	10/30/68	9 mi. NW Margarita Is.	24.5	3
612	10/30/68	10 mi. N Margarita Is.	30	3
613	10/30/68	11 mi. N Margarita Is.	30	4
614	10/30/68	10 mi. N Margarita Is.	26	6
615	10/30/68	8.5 mi. N Margarita Is.	19	3
616	10/31/68	25 mi. ENE Margarita Is.	19	nil
617	10/31/68	7 mi. W Los Testigos Is.	26	nil
618	10/31/68	4 mi. N Los Testigos Is.	34	nil
619	10/31/68	24 mi. SE Los Testigos Is.	36	nil

Table 9.—Drift gill net fishing catches.

	Day fishing			Night fishing		
	Multi	Mono	Total	Multi	Mono	Total
No. of sets	4	4	4	8	8	8
No. of shackles	12	8	20	23	15	38
Soak time/shackle	2h05m	2h05m	2h05m	3h51m	3h51m	3h51m
	No.	No.	No.	No.	No.	No.(lbs)[1]
Leatherjacket		1	1	196	133	329(800)
Spanish mackerel	1		1	81	15	96(216)
Catfish				80	15	95(—)
Shark				12	7	19(—)
Miscellaneous				38	11	49(—)
Total catch	1	1	2	407	181	588(1,016)

[1]Estimated weight.

Table 10.—Anchored gill net fishing catches.

	Trinidad	Tobago
No. of sets	6	3
No. of shackles	6	3
Soak time/shackle	9h23m	12h28m
	No.(lbs)	No.(lbs)
Spanish mackerel	74(196)	4(8)
Jacks	10(20)	3(3)
Sharks	95(139)	-(—)
Miscellaneous	53(62)	-(—)
Total catch	232(417)	7(11)

fathom, 4 inch multifilament gill net caught one small shark.

Thus, with the exception of night sets in the vicinity of Trinidad and Tobago, the gill net efforts put forth by the project were not successful. It is concluded that the method does not lend itself well to circumstances in the West Indies and is not generally recommended.

CONCLUSIONS

Deepwater bottom longlining did not show separate commercial potential and is recommended only as an adjunct to deepwater snapper line or pot fishing. Incidental trawling for shark bait was successful for catching bait and also for catching small quantities of salable food fish.

Fish attraction showed no commercial potential, and exploratory scallop dragging displayed no commercial potential. Even with extensive geographic coverage and wide range of setting techniques, gill netting did not display extensive commercial potential throughout the project region.

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